

THE GENUS SUBULARIA (CRUCIFERAE)¹

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INTRODUCTION

While preparing a flora of the Queen Charlotte Islands, Calder noted that North American plants of *Subularia aquatica* differed from those of Europe and Asia in the shape of the silicles. Subsequent studies by both authors revealed additional morphological characters by which the Old and New World populations can be separated. Although these morphological differences are usually sharp, some nearly intermediate plants occur in western North America. We are recognizing the two populations at subspecific rank, the Old World as ssp. *aquatica* and those of the New World as ssp. *americana*.

There are only two species in the genus *Subularia*, the North American-Eurasiatic *S. aquatica* L. and a plant of high elevations in central Africa, *S. monticola* A. Br. Both species have grass-like leaves, an unusual type of leaf morphology for the family Cruciferae. Plants with similar leaves are frequently found growing in association with both species of *Subularia* throughout their ranges. *Subularia aquatica* is usually associated with *Eleocharis acicularis* (L.) R. & S. and superficially similar species of *Limosella*. In Africa, *S. monticola* occurs with *Limosella africana* Glück and *Scirpus setaceus* L. We suspect that there is some adaptive value for the aquatic *Subularia* in having grass-like leaves.

Hedberg (1957) reports chromosome counts of $2n = 28$ on material of *S. monticola* from Mt. Kenya (Hedberg 1727, 1804). Löve and Löve (1956) reported ca. 36 for material of *S. aquatica* ssp. *aquatica* from Iceland. Observations on plants grown from seed of *S. aquatica* ssp. *americana* from Quebec (Lepage 33, 378) showed the chromosome number to be approximately $2n = 28$. Obviously more chromosome

¹Contribution No. 336 from Plant Research Institute, Canada, Department of Agriculture, Ottawa, Ontario.

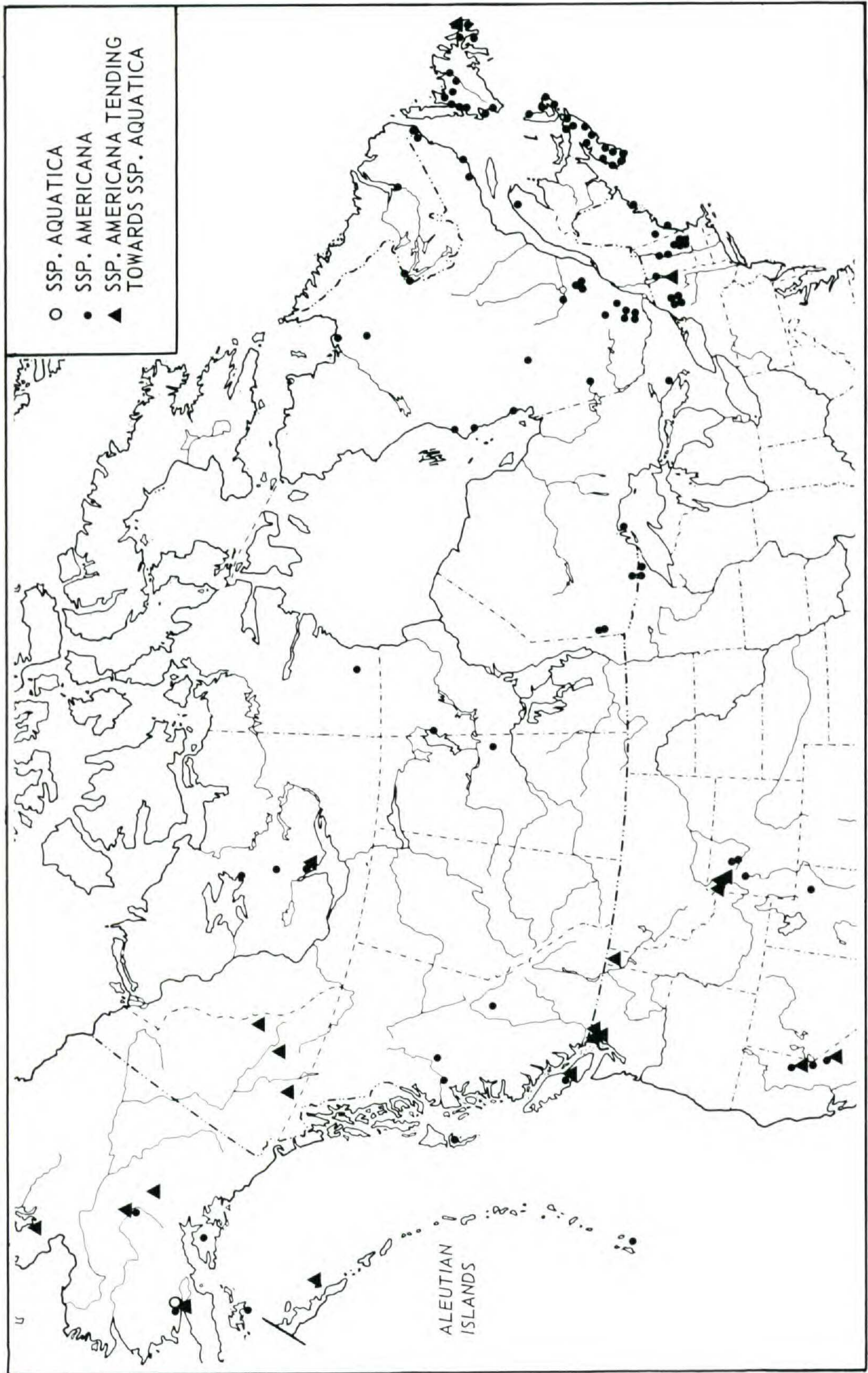


Fig. 1. Distribution of *Subularia aquatica* in North America.

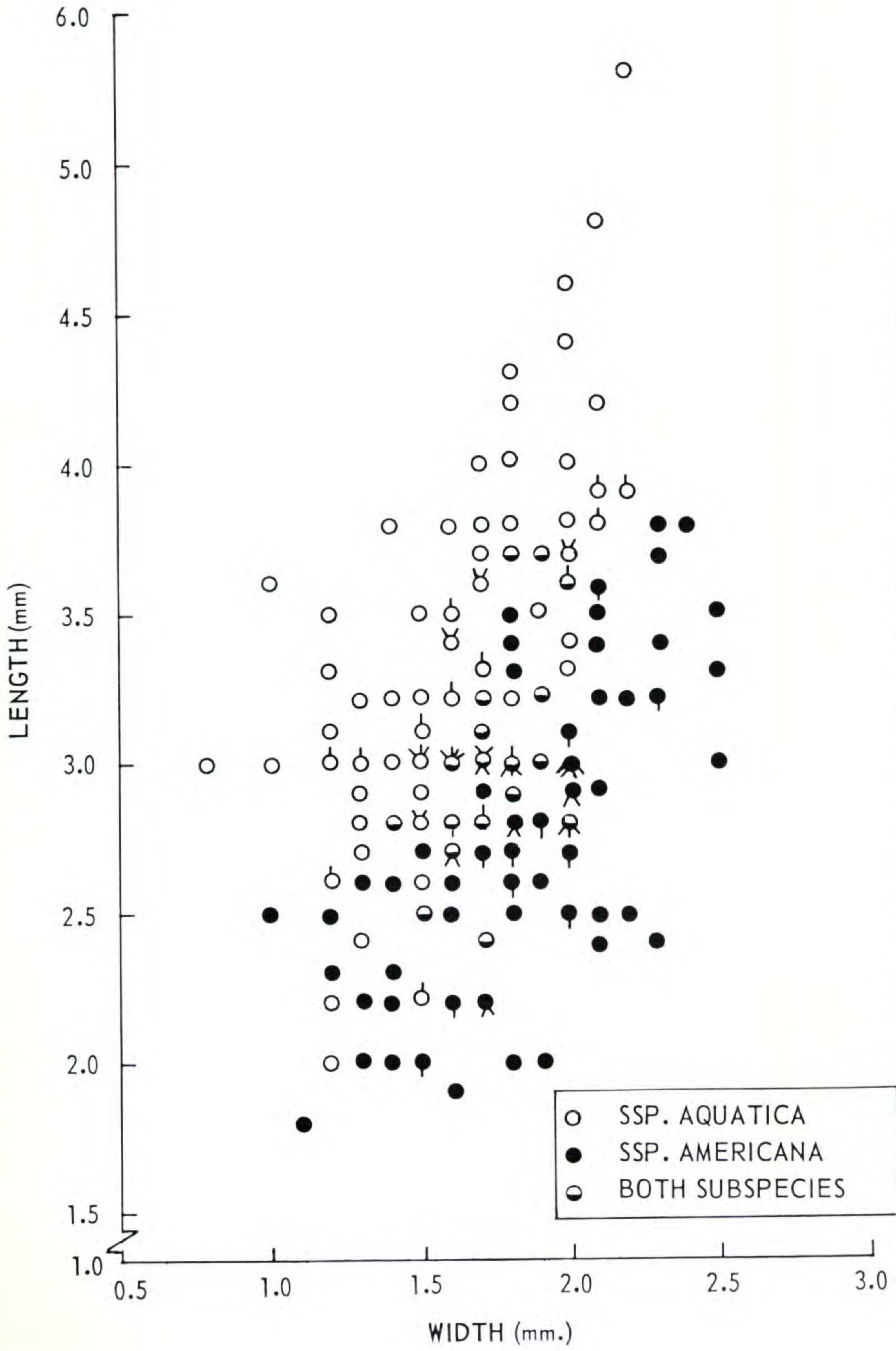


Fig. 2. Scatter diagram comparing width-length ratio of silicles of *ssp. aquatica* and *ssp. americana*. Each arm represents an additional measurement.

determinations are needed for both subspecies of *S. aquatica*.

We would like to express our appreciation to the curators of the following herbaria for the loan of specimens: British Museum of Natural History, London (BM); National Museum of Canada, Ottawa (CAN); Gray Herbarium of Harvard University, Cambridge (GH); Komarov Botanical Institute of the Academy of Sciences, Leningrad (LE); University of New Hampshire, Durham (NHA); New York Botanical Garden, New York (NY); Naturhistoriska Riksmuseum, Stockholm (S); University of California, Berkeley (UC). We also wish to thank Drs. J. H. Soper and M. Raymond for kindly furnishing us with a number of records for Ontario and Quebec.

TAXONOMY

Subularia L., Sp. Pl. 642. 1753. Dwarf, glabrous, aquatic or littoral annuals, usually 2.0-10.0 (-23.0) cm. high; leaves entire, narrowly subulate to linear, 1.0-5.0 (-7.5) cm. long; scape leafless, inflorescence an open to congested raceme, 2-12 (-18)-flowered; sepals 0.7-1.3 mm. long; petals white, slightly exceeding the sepals; stigma entire, sessile; stamens 6; silicles inflated, dehiscent, up to 5.0 mm. long and 2.5 mm. broad, narrowly elliptic to broadly obovate on divaricate to strongly ascending pedicels; seeds light brown, usually up to 6 in each locule, about 1.0 mm. long; flowers apparently self-pollinated and when submerged cleistogamous.

Key to the genus *Subularia*

- Leaves narrowly subulate; stem below lowest pedicel less than 0.5 mm. thick; stem between adjacent pedicels longer than the pedicels. 1. *S. aquatica*.
 Sepals caducous; mature silicles narrowly elliptic to elliptic, rarely broadly elliptic or broadly obovate; lowest pedicel axil frequently 50°-90°. 1a. ssp. *aquatica*.
 Sepals usually persisting at base of silicles; mature silicles elliptic to broadly obovate, rarely elliptic; lowest pedicel axil frequently 30°-50°. 1b. ssp. *americana*.
 Leaves essentially linear, tapering above the middle; stem below lowest pedicel more than 0.5 mm. thick; stem between adjacent pedicels shorter than the pedicels. 2. *S. monticola*.

1. *Subularia aquatica* L.

1a. *Subularia aquatica* L. ssp. *aquatica*, Sp. Pl. 642, 1753. Savage Catalogue (1945) No. 822.1, Linnaean Herbarium, London (LINN; photograph, DAO!).

General distribution. Widely distributed in northern Europe, including Iceland and the Faroe Islands and extending eastward to the Urals. Disjunct to Kamtschatka and Naknek, Alaska. It is of sporadic occurrence in south-central Europe (see distribution map 197, Hultén, 1958).

Almost all plants from the Old World lack sepals at the base of the mature silicles and this single character is sufficient to segregate almost all European plants from those in North America. In addition, the silicles of Eurasiatic plants are usually narrowly elliptic while those from North America are usually broadly obovate.

We have examined over 200 herbarium specimens of ssp. *aquatica*. Included were specimens from all the disjunct areas indicated in Hultén's excellent distribution map of the species. The few Old World collections that differed slightly from most European and Asiatic plants were usually collected at the periphery of its range or in the disjunct areas. One of three collections made by Hartz and Osterfeld in the Faroe Islands in 1897 had plants with nearly subglobose silicles. Two other collections from the Pyrenees in southeastern France and northeastern Spain had atypical fruits. Only one Old World collection might have been included in ssp. *americana*: *Plantae Finlandiae Exsiccatae* (University of Helsingfors) 688, Lapponia Kemensis, Kuolajarvic, Aug. 23, 1910, *Hällstrom* (NY, s, UC). This plant, labelled f. *elongata*, is a close match for a number of atypical specimens of ssp. *americana* from western North America. Almost all other specimens were easily distinguished as ssp. *aquatica*. These included specimens from Bulgaria, and from the Altai, Lake Baikal and Kamtschatka in the U. S. S. R.

The only indication we have that ssp. *aquatica* occurs in North America is a collection from the head of Bristol Bay on the west coast of Alaska: Naknek, July 28, 1946, *Norberg* (UC). Some of the plants of this collection are clearly ssp.

aquatica while others are intermediate between the two subspecies. We also saw typical ssp. *americana* from Naknek.

1b. *Subularia aquatica* L. ssp. **americana** ssp. nov.

A ssp. *aquatica* differt: sepalis saepe perseverantibus; siliculis ellipticis vel late obovatis, raro anguste ellipticis; axilis pedicellorum inferiorum saepe ad 30°-50°.

Type: Big Mushamush Lake, Nova Scotia, *Fernald & Long 457*, [Plantae Exsiccatae Grayanae] (DAO; isotypes CAN, GH, LE, NY, S, UC).

General distribution. Greenland to Aleutian Islands, south to New Hampshire in eastern North America and at high elevations to California and Utah in the west (Fig. 1).

Selected citations: GREENLAND: Tasersuak, Tasermiut Fjord, Sept. 1, 1889, *Hartz* (BM, LE). KEEWATIN DISTRICT: lake on Tha-anne River, *Porsild 6176* (CAN, GH, S). MACKENZIE DISTRICT: McTavish Arm, Great Bear Lake, A. E. & R. T. *Porsild 3696* (CAN, GH, S); Yellowknife, *Cody & Gutteridge 7316* (BM, DAO, NY). ALASKA: Attu Island, Aug. 29, 1891, *Macoun* (CAN, GH, NY, S); Three Saints Bay, Kodiak Island, *Eyerdam 558* (BM, NY, S); Snow River Delta, Kenai Peninsula, *Calder 6586* (DAO, NY, UC); Naknek, *Schofield 2707* (DAO). LABRADOR: Hamilton River, *Gillett & Findlay 5911* (DAO); Blanc Sablon River, *Fernald & Wiegand 3472* (GH, NY); Knob Lake area, *Hustich 576 & 717* (CAN). NEWFOUNDLAND: Tomkins, *Roland & Smith 123* (DAO); Grand Falls, *Fernald et al. 5470* (CAN, GH, NY, UC); Badger Brook, Exploits River, *Robinson & Schrenk 7* (CAN, GH, LE, NY); Birchy Cove, Bay of Islands, *Fernald et al. 3473* (GH, NY). NOVA SCOTIA: Twin Lake, Digby Co., *Fernald & Long 23874* (CAN, GH, LE, NY); Banook Lake, Halifax Co., *Dore et al. 45.1099* (DAO); Warren Lake, Victoria Co., *Smith et al. 5614* (DAO); Salmon Lake, Yarmouth Co., *Fernald et al. 21290* (BM, CAN, GH, NY). QUEBEC: Great Whale River, *Savile 708* (DAO); Fort Chimo, *Calder 2672* (DAO); Lac Grelon, Parc National des Laurentides, *Dansereau & Desmarais 3231* (DAO, S); Lac Monroe, Parc du Mont Tremblant, *Rolland-Germain 71* (CAN, DAO, S, UC); Lac Fortin, Gaspé Co., *Fernald & Collins 590* (CAN, GH). ONTARIO: Eagle Lake, Kenora District, Sept. 13, 1882, *Fletcher* (DAO); Port Sandfield, Lake Muskoka, Sept. 1, 1889, *Britton et al.* (NY); St. Ignace Island, Thunder Bay District, *Garton 6589* (DAO, TRT). MANITOBA: Reindeer Lake, *Baldwin 2439* (CAN, GH). SASKATCHEWAN: Amisk Lake, *Hudson 1401* (DAO). BRITISH COLUMBIA: Lake Kathlyn, Smithers, *Calder et al. 15242* (DAO, UC); Wells, *Taylor 9043* (UBC); Mosquito Lake, Queen Charlotte Islands, *Calder & Taylor 23653* (DAO); Sproat Lake, Vancouver Island, Aug. 12, 1887, *Macoun* (CAN, LE, NY). MAINE: Belgrade Lakes, Kennebec Co., *Gager & Svenson 6360* (GH, UC); Mount Desert Island, Aug. 7, 1906, *Rand* (UC). NEW HAMPSHIRE: Echo Lake, Franconia, Oct. 1, 1887, *Faxon* (GH, LE, NY); Gilmanton, Sept. 24, 1864, *Blake* (GH, NY); Mirror Lake, Tuftonborough, *Pease 19224* (GH); Strafford, Strafford

Co., *Hodgdon et al.* 0395 (NHA). VERMONT: South Pond, Marlboro, Sept. 15, 1895, *Grout & Eggleston* (GH, NY). NEW YORK: Piseco Lake, Hamilton Co., *Muenschler & Lindsey* 3348 (GH, UC); Long Lake, Hamilton Co., *Muenschler & Clausen* 3906 (GH, UC). MINNESOTA: Snow Bank Lake, Lake Co., *Lakela & Elwell* 22420 (GH); Basswood Lake, Lake Co., *Lakela* 18497 (DAO). WYOMING: New Fork Lakes, Sublette Co., *Payson & Payson* 4681 (GH). UTAH: Mirror Lake, Duchesne Co., *Maguire et al.* 4340 (GH, UC). CALIFORNIA: Summit Valley, Sept. 20, 1882, *Pringle* (GH, LE, NY); Weber Lake, Sept. 6, 1886, *Lemmon* (GH); Lake Tahoe, [?Lemmon] (UC).

The following collections of ssp. *americana* tend towards ssp. *aquatica*: YUKON: Mile 222 Canol Road, *Porsild & Breitung* 11503 (CAN, S); Whitehorse, Sept. 1, 1902, *Macoun* (CAN, S). ALASKA: Sanak Island, *Steenis* 4765 (S); Naknek, *Schofield* 2644 (DAO, NY, S); Wonder Lake, Mt. McKinley National Park, *Viereck* 1671 (S, UC). NEWFOUNDLAND: Whitebourne, *Fernald et al.* 26719 (GH). BRITISH COLUMBIA: Somas River near Alberni, *Calder & MacKay* 32136 (DAO). NEW YORK: Lake George, Washington Co., *House* 28318 (GH). WYOMING: Dinwoody Creek, Fremont Co., *Porter* 6207 (DAO, GH, UC); Yellowstone Lake, *Parry* 27 (GH, LE, NY). IDAHO: Priest Lake, *Piper* 3766 (GH, NY, UC). WASHINGTON: Whatcom Lake, Whatcom Co., *Suksdorf* 1936 (GH); Baker Lake, Whatcom Co., *Muenschler* 7912 (GH). CALIFORNIA: Donner Lake, Sept. 1888, *Brandeggee* (UC).

North American specimens of *S. aquatica* collected east of the western boundary of the Precambrian Shield are uniformly quite distinct from European plants of this species. They have extremely persistent sepals, broadly elliptic or broadly obovate silicles and the lowest pedicel axils are from 30° to 50°. There is a distinct gap between this uniform eastern population and a heterogeneous one in the Cordilleran Region of western North America where about half the specimens examined were slightly atypical. The majority of these atypical plants have only a few sepals adhering to the mature silicles and a small proportion entirely lack sepals but do have broadly elliptic or broadly obovate silicles.

The lengths and widths of 100 silicles of both ssp. *aquatica* and ssp. *americana* were plotted in figure 2. The scatter diagram clearly shows a distinct difference between the Old and New World populations in the length to width ratios of the silicles. The range in variation of silicles of both subspecies of *S. aquatica* and also *S. monticola* are shown in Plate 1295.

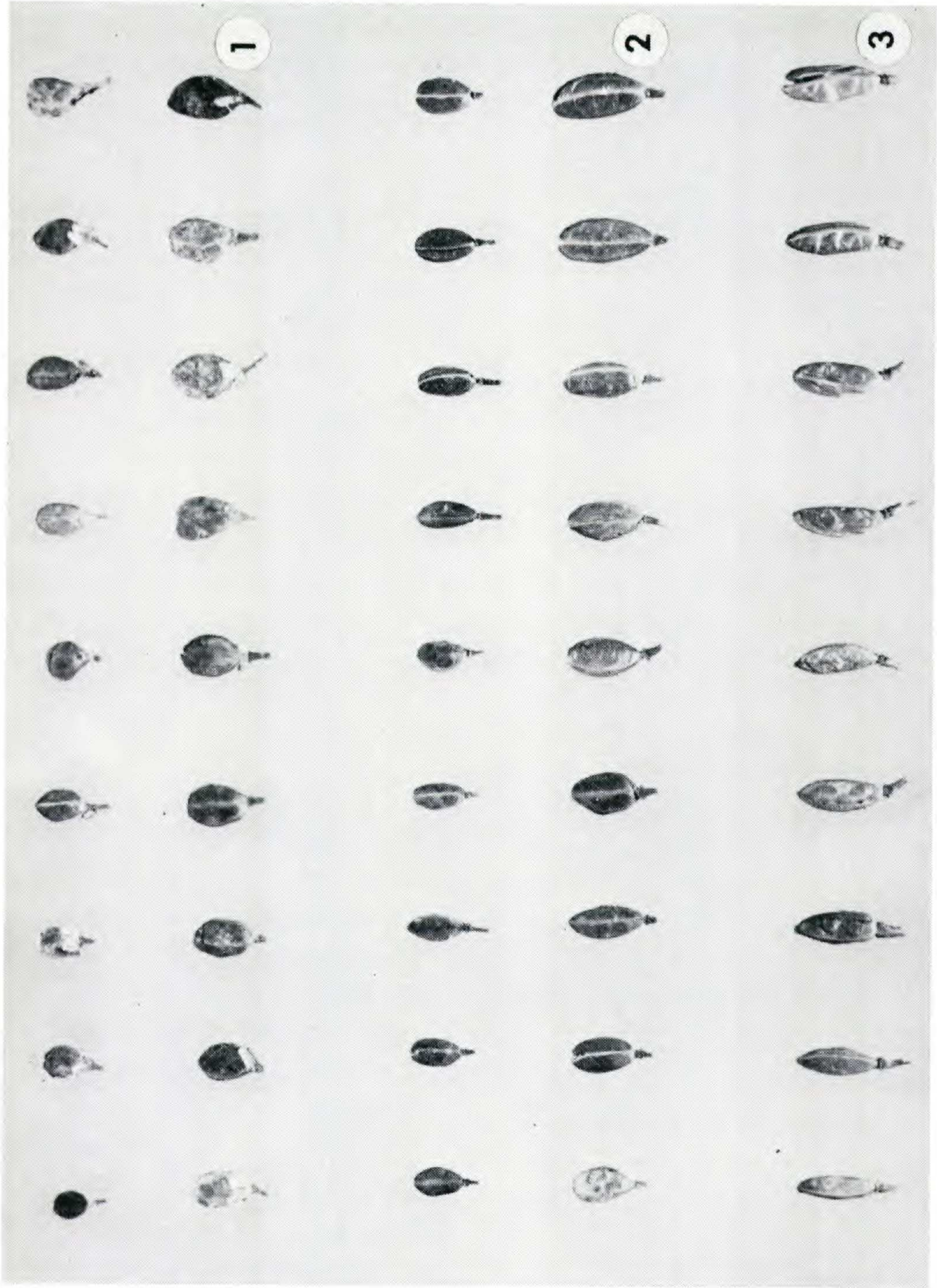


Plate 1295, Figs. 1-3. Silicles of *Subularia*, ca. \times 2. Fig. 1. *S. aquatica* ssp. *americana*. Fig. 2. *S. aquatica* ssp. *aquatica*. Fig. 3. *S. aquatica* ssp. *monticola*.

2. *Subularia monticola* A. Br. ex Schweinf., Beitr. Fl. Aethiop. 76: 1867.

Isotype: Mt. Dedschen, 1400' 7 Oct. 50 [1850] (S! photograph DAO!).

General distribution. At high elevations on the African mountains of Uganda, Congo, Kenya, and Tanganyika (see Hedberg 1957).

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NOTE ON CIMICIFUGA RUBIFOLIA KEARNEY IN VIRGINIA¹ — *Cimicifuga rubifolia* Kearney, known from eastern Tennessee and southern Illinois (as *C. racemosa* var. *cordifolia*) but not previously recorded as growing in Virginia, has been found well established in two locations in Scott County. It was found on the Clinch River between the Tennessee-Virginia state line and Highway 23 near Clinchport on June 22, 1963 (No. 495 and 496), and on the north fork of the Holston River, east of Highway 23, between Kingsport, Tennessee, and Gate City, Virginia, on August 10, 1963 (No. 511). In both areas it grows on north-facing, limestone talus slopes. Voucher specimens are deposited at the University of Tennessee Herbarium and the Virginia Polytechnic Institute Herbarium.

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¹Contribution from the Botanical Laboratory, The University of Tennessee, N. Ser. 248